Journal of the Lepidopterists' Society
51(2), 1997, 156–175

DISTRIBUTION AND PHENOLOGIES OF LOUISIANA SPHINGIDAE

Vernon Antoine Brou, Jr.

and

Charlotte Dozar Brou

74320 Jack Loyd Road, Abita Springs, Louisiana 70420, USA

ABSTRACT. The abundance, distribution, and flight periods for 55 species of Louisiana Sphingidae are presented, including prior literature records and new collecting data for 44 species taken over a 26-year period (1970 through 1995). Information is provided on the number of annual broods for 36 species, and dates of capture are plotted as one-year and composite graphs for 30 species.

Additional key words: bait traps, hawkmoths, light traps, sphinx moths, voltinism.

The first treatment of the family Sphingidae in Louisiana was presented by von Reizenstein (1863), who reported 33 species from the vicinity of New Orleans. Later, von Reizenstein (1881) and Ottolengui (1894) each tallied one additional species for the state, and subsequent published works during this century have gradually expanded the total by another dozen species (see Rothschild & Jordan 1903, Hine 1906, Clark 1917, Draudt 1931, Jung 1950, Merkl & Pfrimmer 1955, Pfrimmer 1957, Brou 1980, Covell 1984, Brou 1994). For some time, we have been monitoring and collecting adult Louisiana Sphingidae in order to produce a comprehensive state list and examine voltinism and variation in the abundance of adults from brood to brood. In the present paper, we discuss the results from 26 years of sampling, 1970 through 1995.

Materials and Methods

We used ultraviolet light traps and fermenting bait traps to attract sphingids, logging approximately 416,000 light trap hours and 633,000 bait trap hours from 1970 through 1995. Occasional sampling was done using hand nets, flight traps, and pitfall traps. Many different light trap designs were used, but generally the traps employed lamps with adjacent baffles mounted over a funnel (see Brou 1992a, 1992b for details). Most of the lamps were black lights, ranging from 15 to 1000 watts, used singly, or in various combinations. Light traps varied from 60 to 3500 watts each, though most were in the 250 to 600 watt range. As many as six light traps were operated dusk to dawn, irrespective of climatic conditions, using photoelectric controls. Up to eight bait traps were operated year-round during 1984–1995.

Brood numbers were estimated by examining yearly graphs of capture totals plotted against sampling date for individual sphingid species. Ap-

proximately 2000 such graphs were prepared and studied, yielding data sufficient to estimate the number of annual broods for 36 species. Representative single-year graphs and composite-year graphs are presented in Figs. 3–52 (see Results and Species Accounts for discussion).

Specimens retained during this study are deposited at several institutional and private collections, the largest numbers of specimens being in the Florida State Collection of Arthropods (Gainesville), Louisiana State University (Baton Rouge) and in the collection of the senior author. Most specimens were from nine locations that were monitored on a frequent or continuous basis. These were, in decreasing order of sampling intensity: St. Tammany Parish, Sec. 24, T6, SR12E, 6.8 km NE Abita Springs; St. John the Baptist Parish, Edgard; Iberville Parish, Sunshine; Lafourche Parish, Cut Off; West Feliciana Parish, Sec. 63 and Sec. 76, T1S, R3W, 3.2 km NE Turnbull/Weyanoke; Ascension Parish, Prairieville; Tangipahoa Parish, Fluker; Natchitoches Parish, Kisatchie National Forest; Orleans Parish, New Orleans. Nomenclature follows Hodges (1983) with minor modifications.

RESULTS

General Trends. A total of 71,836 specimens of 55 species of Sphingidae was sampled from 43 of 64 Louisiana parishes (Fig. 1). Of the remaining 21 parishes, some were not visited, and a few yielded no Sphingidae. The greatest number of species (40) was recorded from St. Tammany Parish. Distribution maps for each of the 55 species are presented in Figs. 2.1–2.55, using data from our study supplemented by those few prior literature records for which accurate locality information could be determined.

Table 1 lists the monthly sampling totals from our study for each of the 55 species. Over 96 percent of the specimens came to light or bait during the period March to September. All 55 of the sphingid species that we sampled came to ultraviolet light traps (including *Hemaris thysbe* (F.), *H. diffinis* (Bdv.), and *Amphion floridensis* B. P. Clark). *Darapsa myron* (Cram.) was the most common species, accounting for over 26 percent of the total. Species more often taken in fermenting bait traps included *Sphinx kalmiae* Neum., *Enyo lugubris* (L.), *Sphecodina abbottii* (Swainson), *A. floridensis*, *D. myron*, and *Darapsa pholus* (Cram.) (Platt (1969) reported collecting some of these same species at fruit bait). Several specimens each of species not generally known to be attracted to fermenting bait were taken by this method, including *Laothoe juglandis* (J. E. Smith), *H. diffinis*, *Darapsa versicolor* (Harr.), and *Xylophones tersa* (L.). Several *Agrius cingulata* (F.) and *Amphion floridensis* were captured in pitfall traps baited with a mixture of feces, water, and ethylene glycol.

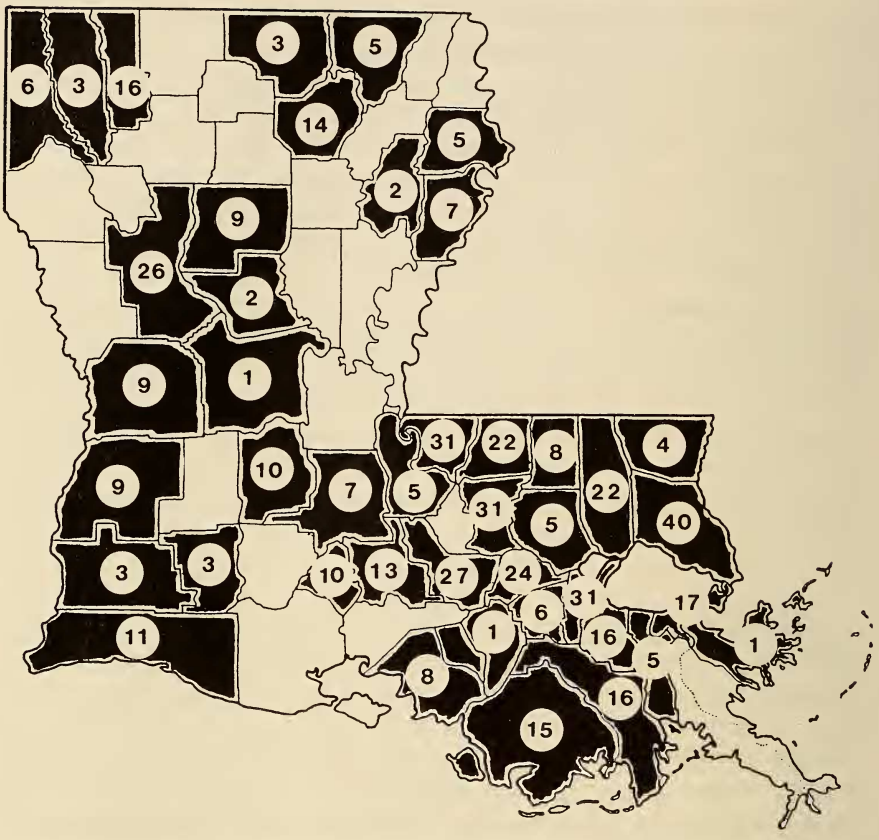
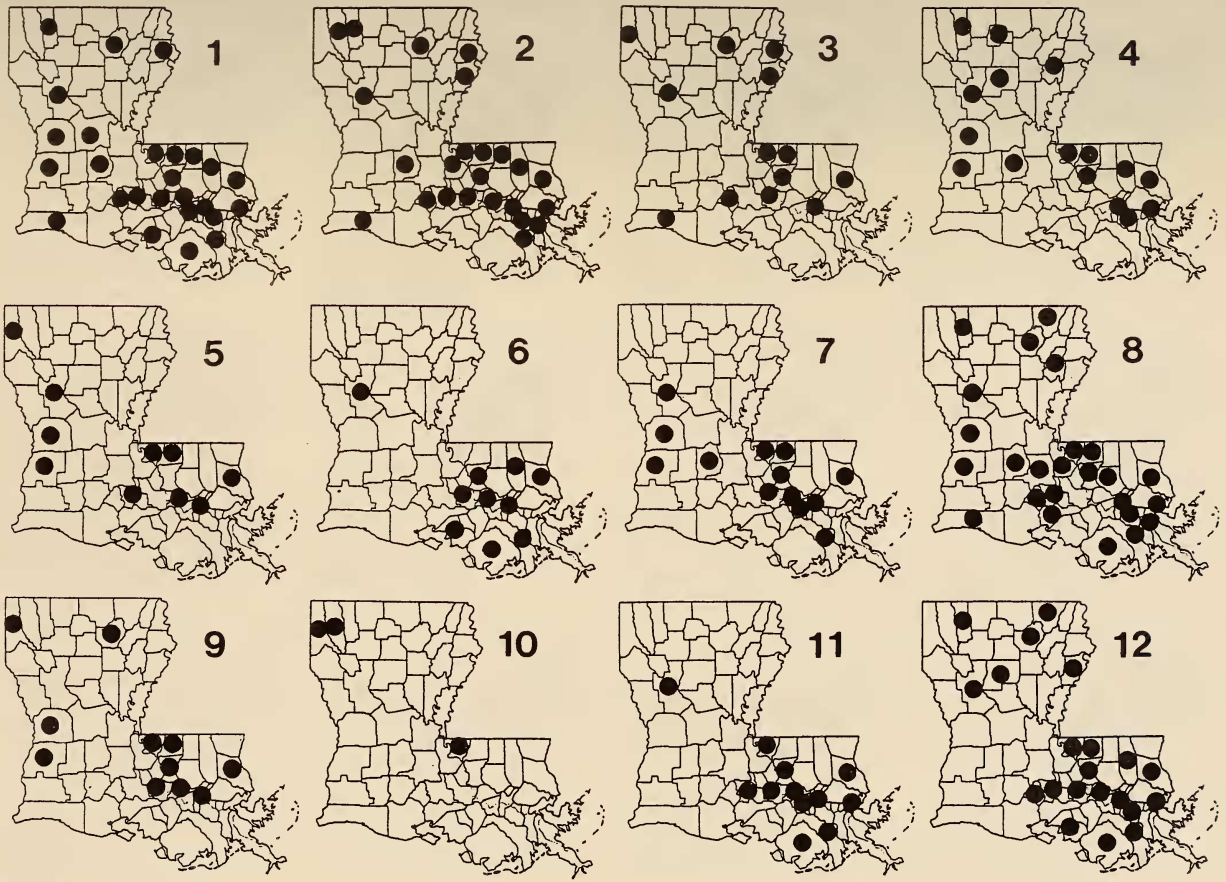
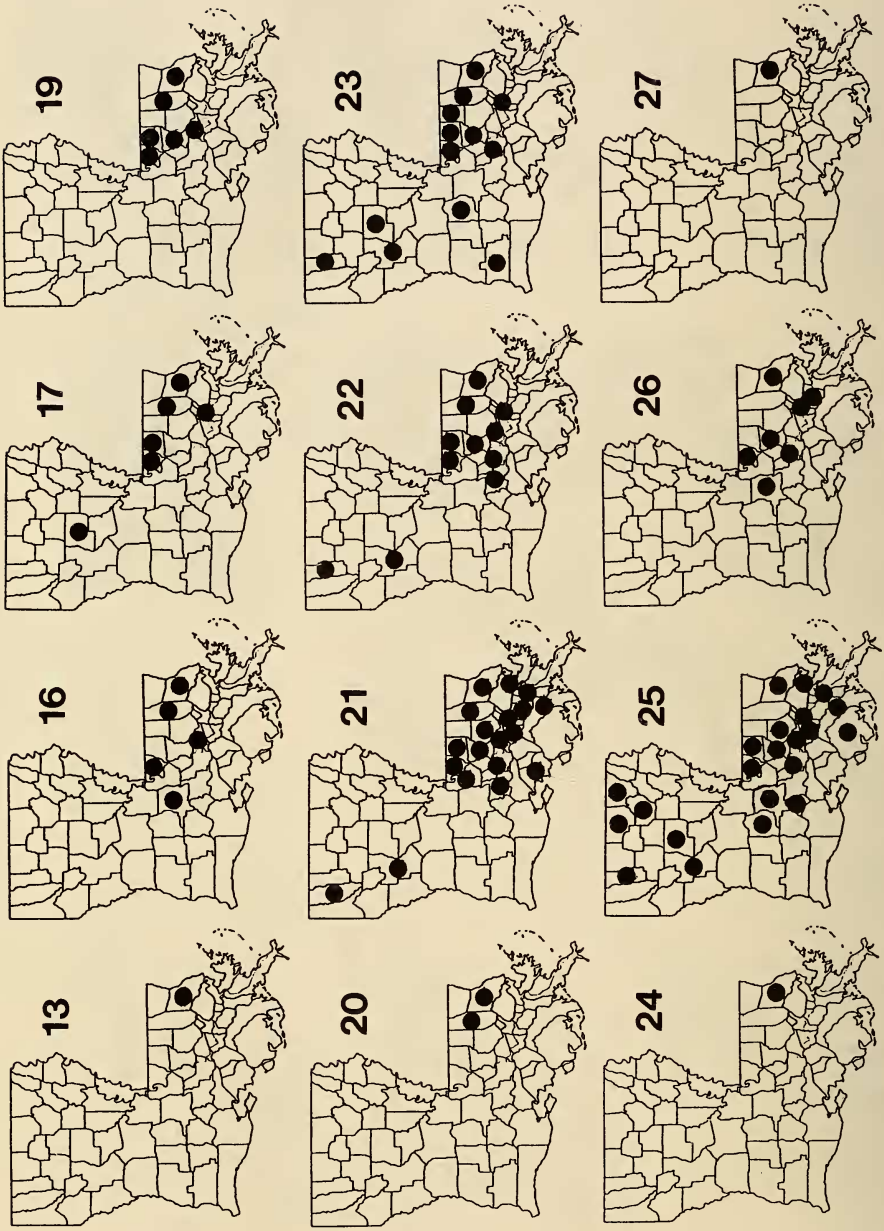


FIG. 1. Number of Sphingidae species recorded for each Louisiana parish, from sampling during 1970–1995.

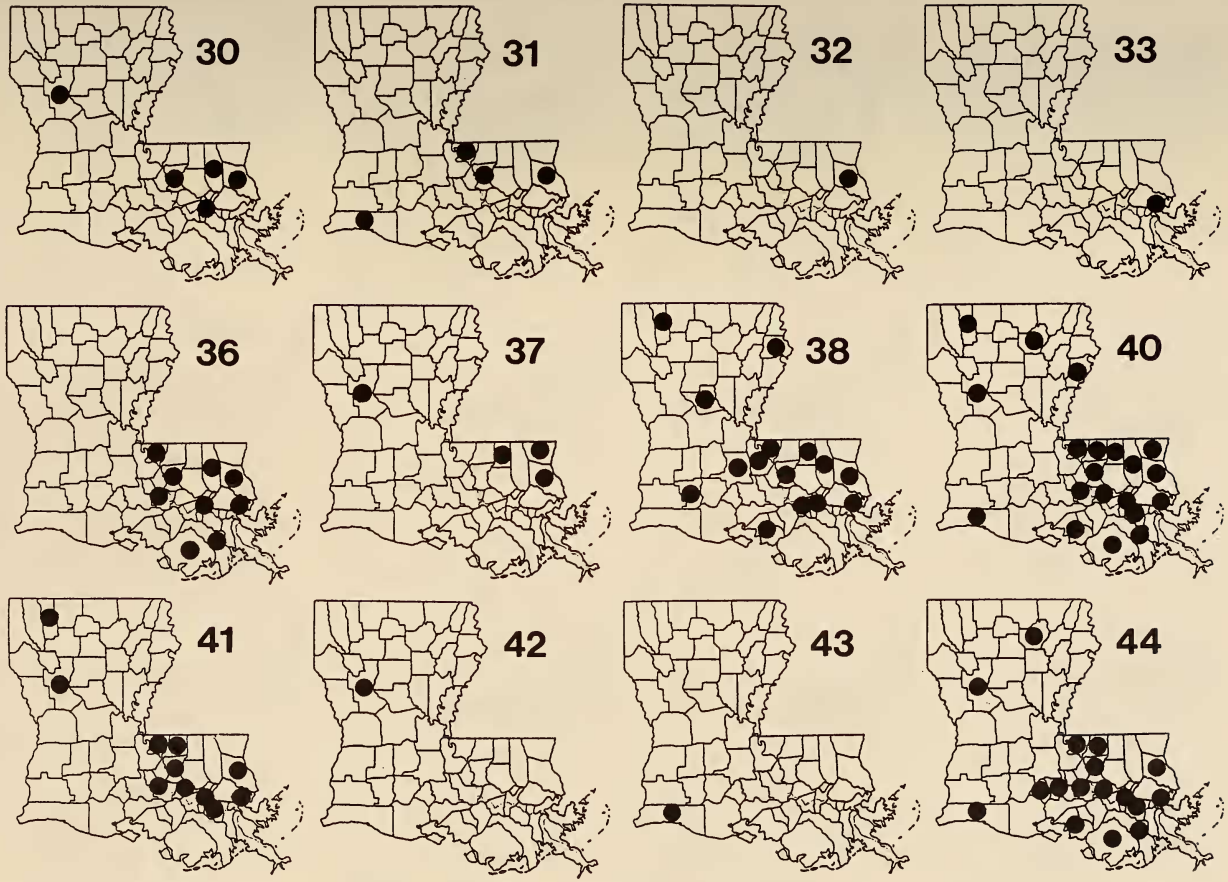
A total of 47 of the 55 species had been recorded previously from Louisiana, and 8 are reported here as new state records (B in Table 1). We failed to locate six species recorded by von Reizenstein (1863, 1881) (V in Table 1), two recorded by Jung (1950) (J in Table 1), and one recorded by Ottolengui (1894) (O in Table 1). We have been unable to locate specimens from the literature reports tabulated earlier, and Jung (pers. comm.) indicated that specimens taken during his investigation no longer exist. Two species, *Sphinx leucophaeta* Clem. and *Sphinx chersis* (Hbn.), reported by von Reizenstein (1863) seem questionable, although these species are known from one or more adjoining states. These records may actually refer to *Sphinx franckii* Neum., which was not recognized and named until 30 years after von Reizenstein's publication. Ottolengui's (1894) report of *Eumorpha licaon* (Cram.) likely was



FIGS. 2.1–2.12. Distributions of Louisiana Sphingidae. Map number corresponds to number for species in Table 1.



FIGS. 2.13–2.27. Distributions of Louisiana Sphingidae. Map number corresponds to number for species in Table 1.



FIGS. 2.30–2.44. Distributions of Louisiana Sphingidae. Map number corresponds to number for species in Table 1.

FIGS. 2.45–2.55. Distributions of Louisiana Sphingidae. Map number corresponds to number for species in Table 1.

Eumorpha intermedia (B. P. Clark), a similar, smaller species, not described until 23 years later.

Among sphingid surveys from adjoining states, Freeman (1938) recorded 32 species from Arkansas, and only one of his species, *Sphinx gordius* Cramer, remains unrecorded from Louisiana (Riotte (1980) suggested that this record was probably *Sphinx poecila* Stephens). All the sphingids in the following three surveys are known from Louisiana: the 28 species listed by Selman and Barton (1971) from northeastern Arkansas; the 26 species listed by Neck (1991) from Walker County, Texas; and the 24 species listed by Taylor and Taylor (1965) from the Gulf Coast of Mississippi.

Annual Brood Patterns. We were able to estimate the number of annual broods in Louisiana for 36 of 55 species of Sphingidae (see Species Summaries). Nearly all of our findings differ from previously published sphingid voltinism in other states (e.g., Beutenmuller 1895, Hodges 1971, Covell 1984, Heitzman 1987), with Louisiana's southerly location generally promoting additional broods. For many of the multibrooded species, the interval between the first brood peak and the second brood peak in any given year proved to be sometimes two times greater than the intervals between the remaining brood peaks; these subsequent intervals were usually consistent, or nearly so, throughout the remainder of the year. This initial nonconforming brood interval is of different duration depending on the species. The initial spring broods of some species can also be quite protracted, likely influenced at least in part by unpredictable spring climatic influences upon both the moths and their foodplants. The initial brood peaks varied by a month or more from one year to another. Variability in initial brood emergence appears to affect the timing of subsequent broods, but the magnitude of the effect differs in any given year.

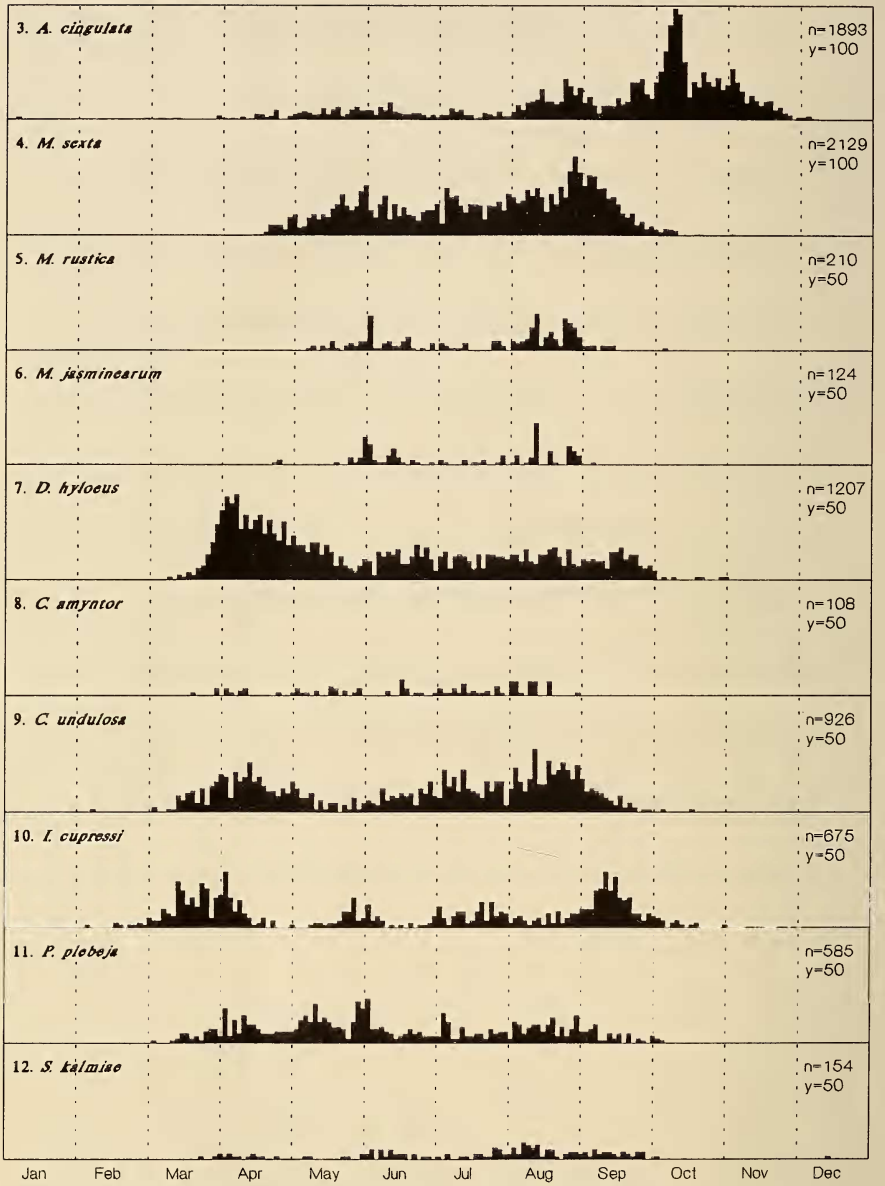
Certain annual broods in some species also tend to be consistently small or large, and these relative brood sizes tend to repeat from year to year. For example, the fourth annual brood of *Darapsa myron* is typically the smallest, and is bordered by the two largest broods (three and five) (Figs. 29, 33). For *Sphecodina abbottii*, the second and especially the fourth broods are reduced (the fourth may in fact represent a frequently observed partial brood). The composite-year graph for *S. abbottii* (Fig. 25) masks these small broods, but the trends are more apparent when individual years are examined (cf. Fig. 34). A similar pattern can be seen in *D. pholus*, in which broods occur at approximately monthly intervals. Broods one, three, five, and six are usually more populous than broods two, four, and seven. On the composite-year graph (Fig. 30), broods five through seven merge together and give the impression of a single, final brood (cf. Fig. 35). Why some multibrooded species have

TABLE 1. Numbers and identities of Sphingidae sampled from 1970 to 1995 in Louisiana, by month. B = new state records from the authors' sampling. Other letters represent species recorded for Louisiana in the literature but not sampled by the authors: V = von Reizenstein (1863, 1881), J = Jung (1950), O = Ottolengui (1894). Some specimens recorded as *Lapara coniferarum* from 1970–1985 represent *L. phaeobrachycerous*, since records of the two were not segregated until 1986; records for *L. phaeobrachycerous* represent only those for the period 1986–1995. Asterisks indicate species sampled outside the period 1970–1995: *Eumorpha labruscae* is included on the basis of a single female taken in 1964 at Houma, Terrebonne Parish (month uncertain), and *Pachylia ficus* is included on the basis of a single male taken in 1996 at New Orleans.

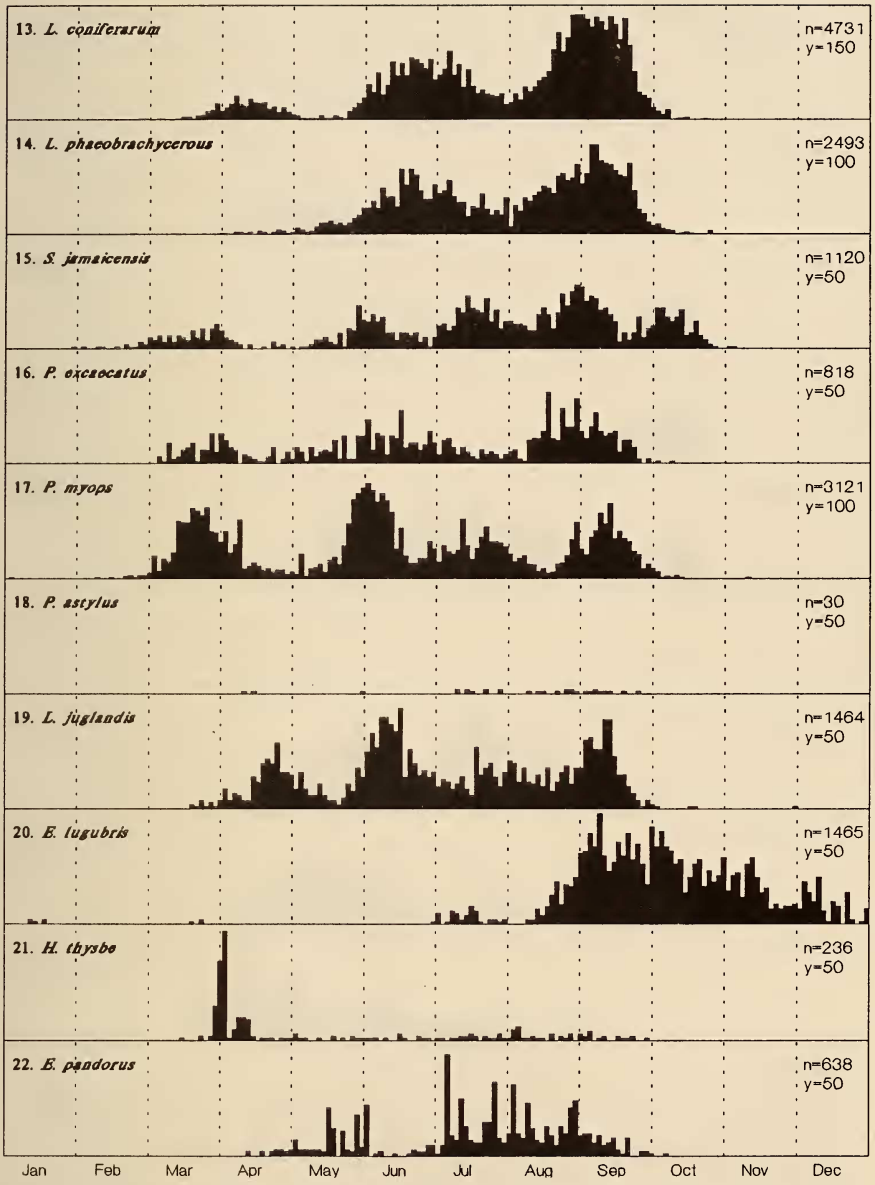
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1. *Agrius cingulata* (F.)	2	1	6	31	110	93	75	295	302	761	212	5	1893
2. *Manduca sexta* (L.)	0	0	0	64	342	320	413	600	370	19	1	0	2129
3. *M. quinquemaculata* (Haw.)	0	0	1	6	4	4	7	14	20	4	0	0	60
4. *M. rustica* (F.)	0	0	0	0	26	43	22	108	10	1	0	0	210
5. *M. jasminearum* (Guer.)	0	0	0	3	20	32	14	54	1	0	0	0	124
6. *Dolba hyloeus* (Drury)	0	0	80	388	165	144	145	151	128	6	0	0	1207
7. *Ceratomia amyntor* (Geyer)	0	0	4	10	21	15	27	31	0	0	0	0	108
8. *C. undulosa* (Wlk.)	0	1	83	185	64	104	162	258	67	2	0	0	926
9. *C. catalpae* (Bdv.)[B]	0	0	0	4	1	7	8	11	19	1	0	0	51
10. *C. hageni* (Grt.)[B]	0	0	0	2	3	4	2	1	0	0	0	0	12
11. *Isoparce cupressi* (Bdv.)	0	9	156	84	48	34	90	62	175	17	0	0	675
12. *Paratreia plebeja* (F.)	0	0	35	100	148	80	72	106	41	3	0	0	585
13. *Sphinx eremitus* (Hbn.)[B]	0	0	0	0	0	0	0	3	0	0	0	0	3
14. *S. leucophaeta* Clem.[V]	0	0	0	0	0	0	0	0	0	0	0	0	0
15. *S. chersis* (Hbn.)[V]	0	0	0	0	0	0	0	0	0	0	0	0	0
16. *S. franckii* Neum.	0	0	0	0	3	4	1	4	0	0	0	0	12
17. *S. kalmiae* J. E. Smith	0	0	3	12	6	25	23	52	31	1	0	1	154
18. *S. drupiferarum* J. E. Smith[V]	0	0	0	0	0	0	0	0	0	0	0	0	0
19. *Lapara coniferarum* (J. E. Smith)	0	2	105	500	241	1648	1286	2275	2402	59	0	0	8518
20. *L. phaeobrachycerous* Brou	0	0	1	43	205	661	520	860	902	37	0	0	3229
21. *Smerinthus jamaicensis* (Drury)	1	13	92	27	80	112	227	248	187	131	2	0	1120
22. *Paonias excaecatus* (J. E. Smith)	0	0	75	61	94	167	84	227	153	3	0	0	864
23. *P. myops* (J. E. Smith)	1	15	623	256	432	651	505	303	555	14	1	0	3356
24. *P. astylus* (Drury)[B]	0	0	0	2	1	0	9	9	9	0	0	0	30
25. *Laothoe juglandis* (J. E. Smith)	0	0	14	191	138	402	217	226	272	3	1	0	1464

TABLE 1. (continued)

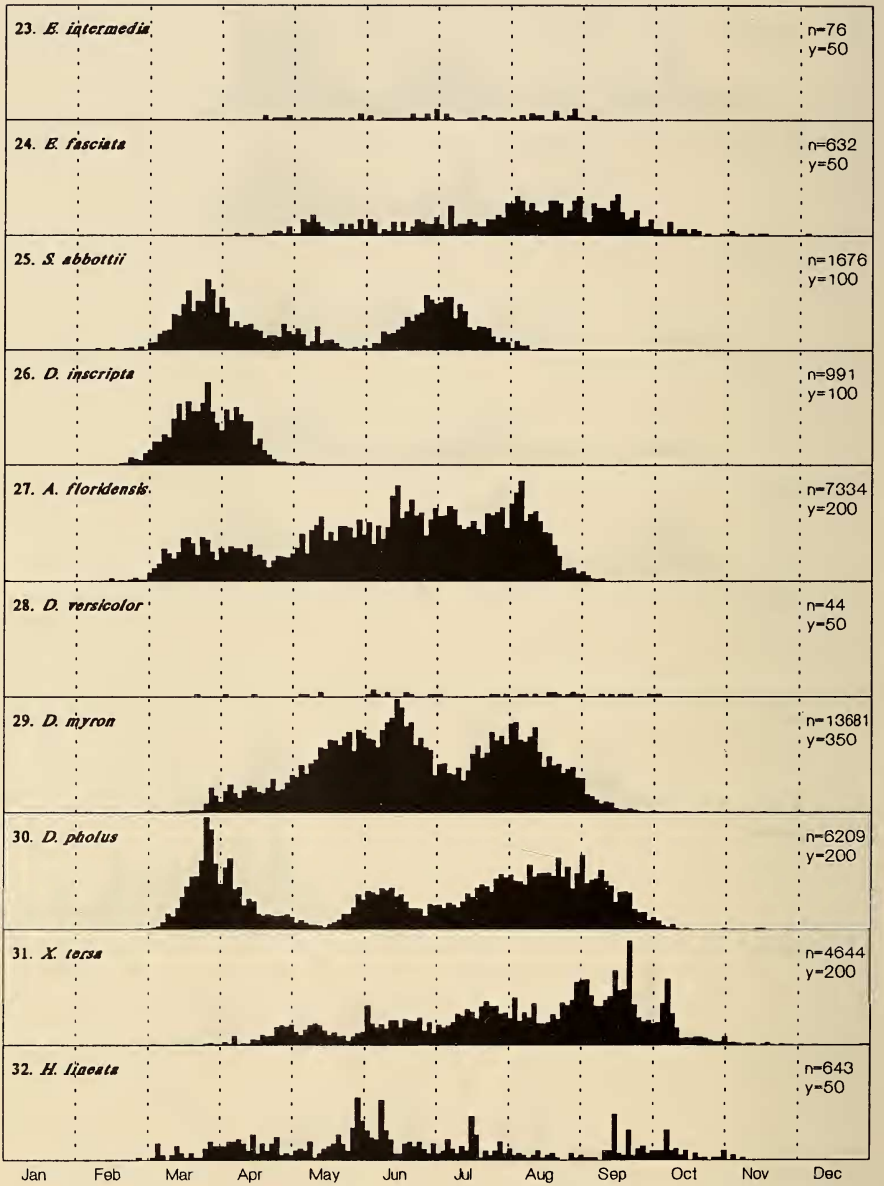
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
26. *Pachyspinx modesta* (Harr.)	0	0	1	0	2	5	3	18	0	0	0	0	29
27. *Pseudosphinx tetrio* (L.)	0	0	0	0	0	0	0	0	0	0	2	0	2
28. *Erynnis alope* (Drury)[J]	0	0	0	0	0	0	0	0	0	0	0	0	0
29. *E. lassauxi* (Bdv.)[J]	0	0	0	0	0	0	0	0	0	0	0	0	0
30. *E. ello* (L.)	0	0	0	0	0	1	1	1	0	2	1	0	6
31. *E. obscura* (F.)	0	0	0	0	1	0	0	1	1	1	1	0	5
32. *E. domingonis* (Btl.)[B]	0	0	0	0	0	0	1	0	0	0	0	0	1
33. *Pachylia ficus* (L.)[B*]	1	0	0	0	0	0	0	0	0	0	0	0	1
34. *Aellopos titan* (Cram.)[V]	0	0	0	0	0	0	0	0	0	0	0	0	0
35. *A. fadus* (Cram.)[V]	0	0	0	0	0	0	0	0	0	0	0	0	0
36. *Enyo lugubris* (L.)	5	0	3	0	0	1	45	152	505	411	223	120	1465
37. *Hemaris thysbe* (F.)	0	0	32	111	14	12	22	29	16	0	0	0	236
38. *H. diffinis* (Bdv.)	0	0	0	1	2	1	76	15	11	1	0	0	107
39. *Eumorpha satellita licaon* (Cram.)[O]	0	0	0	0	0	0	0	0	0	0	0	0	0
40. *E. pandorus* (Hbn.)	0	0	0	15	97	44	207	203	71	1	0	0	638
41. *E. intermedia* (B. P. Clark)	0	0	0	7	12	21	12	22	2	0	0	0	76
42. *E. achemon* (Drury)	0	0	0	0	1	0	0	2	0	0	0	0	3
43. *E. vitis* (L.)	0	0	0	0	0	0	0	0	5	0	0	0	5
44. *E. fasciatus* (Sulz.)	0	0	0	13	67	70	105	202	142	26	6	1	632
45. *E. labruscae* (L.)[B*]	0	0	0	0	0	0	0	0	0	(1)	(1)	0	1
46. *Sphecodina abbottii* (Swainson)[B]	0	9	513	294	117	350	372	21	0	0	0	0	1676
47. *Deidamia inscripta* (Harr.)	0	28	606	350	7	0	0	0	0	0	0	0	991
48. *Amphion floridensis* B. P. Clark	1	27	902	823	1590	1906	2055	1332	28	2	0	0	8666
49. *Proserpinus gaurae* (J. E. Smith)[V]	0	0	0	0	0	0	0	0	0	0	0	0	0
50. *Darapsa versicolor* (Harr.)	0	0	1	2	4	12	4	13	7	1	0	0	44
51. *D. myron* (Cram.)	0	0	206	1436	4090	4937	4096	3709	333	13	1	0	18821
52. *D. pholus* (Cram.)	0	1	1043	728	312	775	967	1477	870	34	2	0	6209
53. *Xylophanes pluto* (F.)	0	0	0	0	0	1	0	0	0	0	0	0	1
54. *X. tersa* (L.)	0	0	12	222	359	599	867	1020	1297	440	29	3	4848
55. *Hyles lineata* (F.)	0	1	48	94	124	139	88	30	69	47	3	0	643
Total records	11	107	4645	6065	8951	13424	12830	14145	9001	2041	485	130	71836
Species per month	6	11	25	32	37	36	37	39	32	28	14	5	



FIGS. 3–12. Phenologies of Louisana Sphingidae: composite-year graphs for individual species, data summed from 1970–1995. Specimens sampled (n) and number of specimens represented by entire vertical axis (y) given at right. **3,** *Agrius cingulata*; **4,** *Manduca sexta*; **5,** *M. rustica*; **6,** *M. jasminearum*; **7,** *Dolba hyloeus*; **8**, *Ceratomia amyntor*; **9**, *C. undulosa*; **10,** *Isoparce cupressi*; **11,** *Paratrea plebeja*; **12,** *Sphinx kalmiae*.



FIGS. 13–22. Phenologies of Louisana Sphingidae: composite-year graphs for individual species, data summed from 1970–1995. Specimens sampled (n) and number of specimens represented by entire vertical axis (y) given at right. **13,** *Lapara coniferarum*; **14,** *L. phaeobrachycerous*; **15,** *Smerinthus jamaicensis*; **16,** *Paonias excaecatus*; **17,** *P. myops*; **18,** *P. astylus*; **19,** *Laothoe juglandis*; **20,** *Enyo lugubris*; **21,** *Hemaris thysbe*; **22,** *Eumorpha pandorus*.



FIGS. 23–32. Phenologies of Louisana Sphingidae: composite-year graphs for individual species, data summed from 1970–1995. Specimens sampled (n) and number of specimens represented by entire vertical axis (y) given at right. **23,** *Eumorpha intermedia*; **24,** *E. fasciata*; **25,** *Sphecodina abbottii*; **26,** *Deidamia inscripta*; **27,** *Amphion floridensis*; **28,** *Darapsa versicolor*; **29,** *D. myron*; **30,** *D. pholus*; **31,** *Xylophanes tersa*; **32,** *Hyles lineata*.

reduced population sizes for certain broods remains unclear. No doubt climatic extremes (e.g., rainfall, drought) and biological influences (e.g., predators, parasites) play a role, but we neither systematically studied nor found obvious correlations between these factors and observed brood sizes and timings.

The approximate 30-day brood cycles that were exhibited by many species are not sampling artifacts related to the lunar cycle, as species attracted to fermenting bait showed the same cyclical patterns as those attracted to light. A good example is *E. lugubris* in 1991 (Fig. 36). This species is attracted to both light and bait. The initial 1991 brood occurred in early to mid July, roughly coinciding with a new moon. Broods two through five peaked at about 28-day intervals beginning in early September, and these subsequent brood peaks did not coincide with either new or full moons (persistent cold weather during December 1991 prevented collection of sixth brood specimens). Similarly, *L. phaeobrachycerous* Brou in 1991 (Fig. 37) showed brood peaks not correlated with lunar phase. Few specimens of the initial brood were collected in early May, as is normally true for this species, and the remaining four brood peaks occured at about 30-day intervals between new and full moons, beginning in early June.

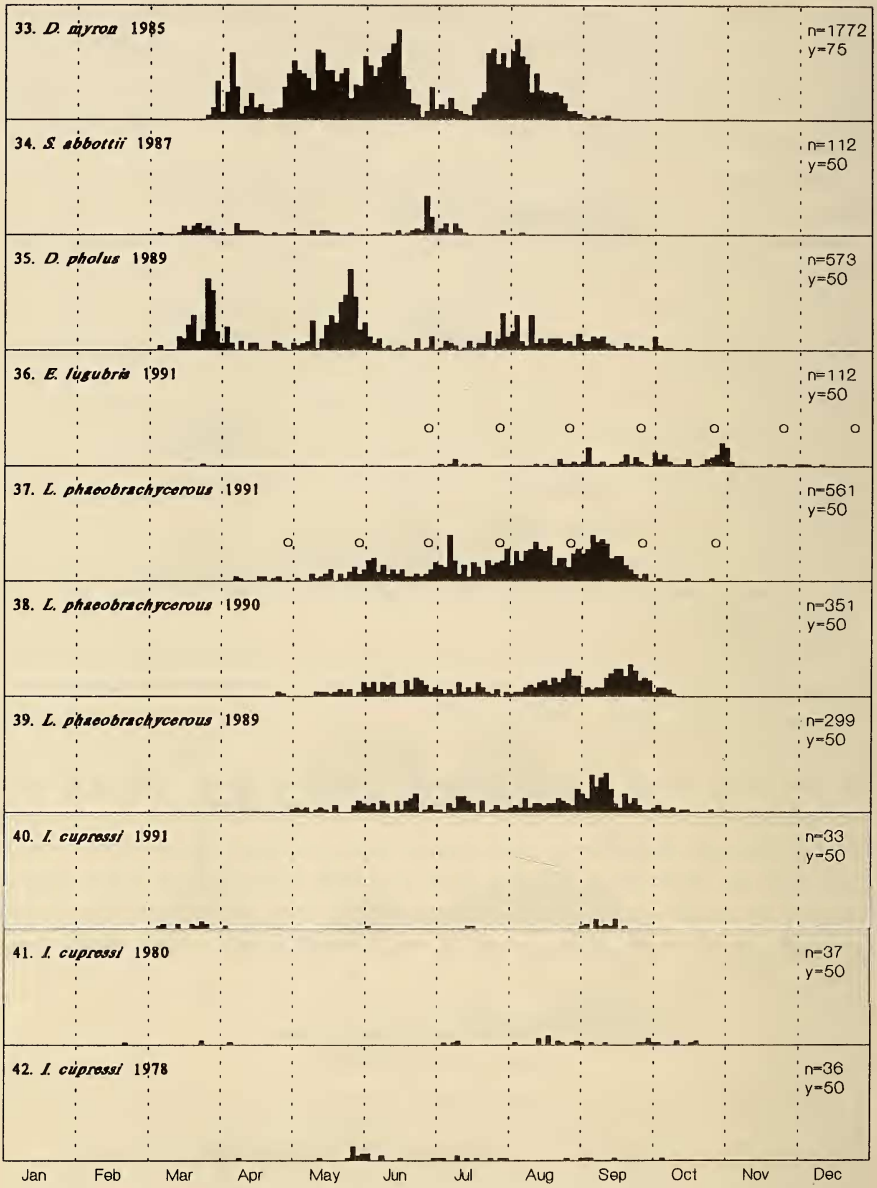
For species often seen only at low numbers, representative specimens for each brood were not observed in some years. An example is *Isoparce cupressi*. During 1991, only 14 specimens of the initial brood were taken (Fig. 40); a single specimen for the second brood; two specimens for the third brood; and 16 specimens for the fourth brood. In 1980 (Fig. 41), no specimens were collected at the usual emergence time of the second brood, though there were specimens representing broods three, four, and five. In 1978 (Fig. 42), the first and fifth broods were each represented by single specimens, whereas broods two, three, and four were represented by multiple specimens. In 1973 (Fig. 43), only broods two, three, and four were represented.

SPECIES SUMMARIES

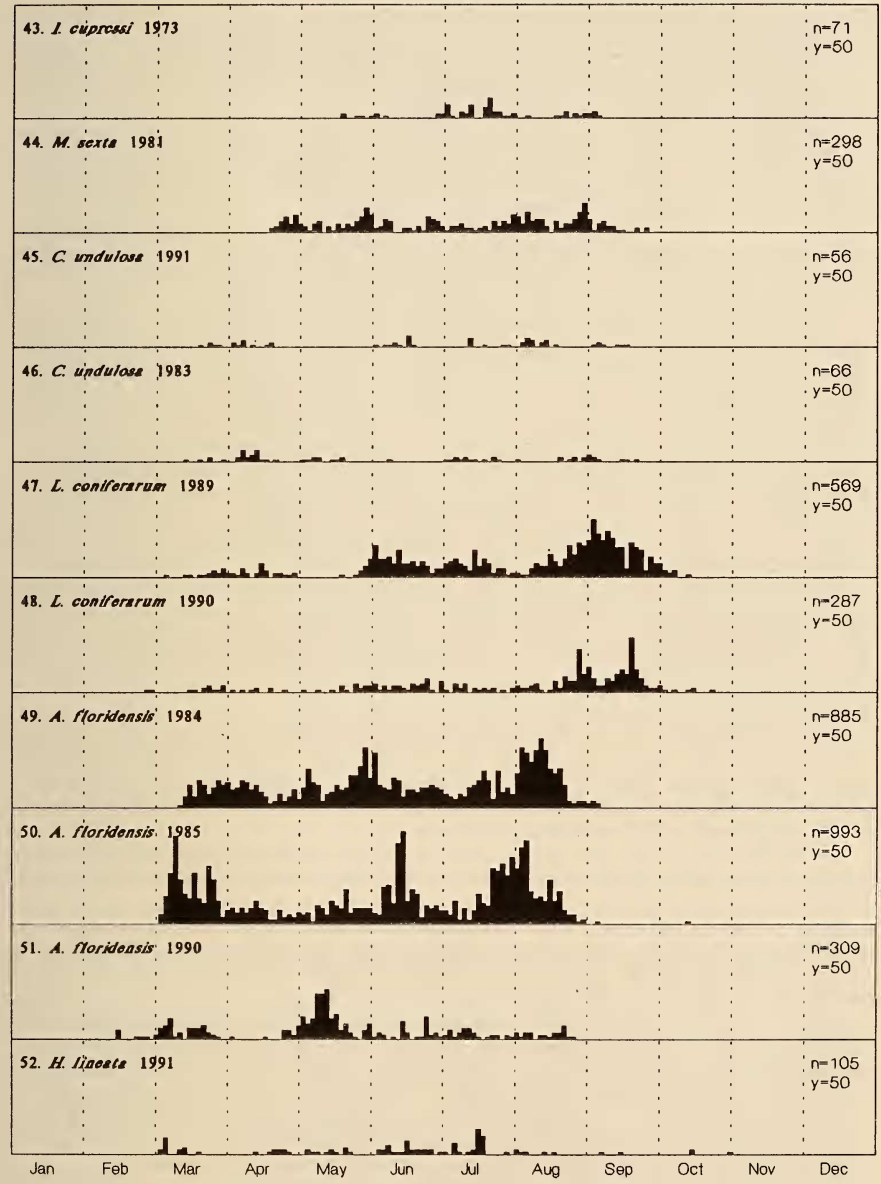
Agrius cingulata (F.) (Fig. 3): seven broods, first peaking late April to early May; peaks two through seven occur at approximately 30-day intervals, beginning early to mid-June; occasional December specimens may indicate partial emergence of an eighth brood.

Manduca sexta (L.) (Figs. 4, 44): five broods peaking at approximately 30-day intervals, beginning at the end of April; occasional October specimens may indicate partial emergence of a sixth brood; previously reported by Beutenmuller (1895) as double-brooded near New York City, and by Heitzman (1987) as having two or more broods in Missouri.

Manduca quinquemaculata (Haw.): five broods, first peaking approximately mid April; peaks two through five occur at approximately 30-day intervals, beginning early June; occasional October specimens may indicate partial emergence of a sixth brood; previously reported by Beutenmuller (1895) as double-brooded near New York City, and by Heitzman (1987) as having two or more broods in Missouri.



FIGS. 33–42. Phenologies of Louisana Sphingidae: single-year graphs for individual species. Specimens sampled (n) and number of specimens represented by entire vertical axis (y) given at right. Full moons on Figs 36, 37 indicated by open circles (see text for elaboration). **33,** *Darapsa myron*, 1985; **34,** *Sphecodina abbottii*, 1987; **35,** *Darapsa pholus*, 1989; **36,** *Enyo lugubris*, 1991; **37,** *Lapara phaeobrachycerous*, 1991; **38,** *L. phaeobrachycerous*, 1990; **39,** *L. phaeobrachycerous*, 1989; **40,** *Isoparce cupressi*, 1991; **41,** *I. cupressi*, 1980; **42,** *I. cupressi*, 1978.



FIGS. 43–52. Phenologies of Louisana Sphingidae: single-year graphs for individual species. Specimens sampled (n) and number of specimens represented by entire vertical axis (y) given at right. **43,** *Isoparce cupressi*, 1973; **44,** *Manduca sexta*, 1981; **45,** *Ceratomia undulosa*, 1991; **46,** *C. undulosa*, 1983; **47,** *Lapara coniferarum*, 1989; **48,** *L. coniferarum*, 1990; **49,** *Amphion floridensis*, 1984; **50,** *A. floridensis*, 1985; **51,** *A. floridensis*, 1990; **52,** *Hyles lineata*, 1991.

Manduca rustica (F.) (Fig. 5): four broods, first peaking at the end of May; peaks two through four occur at approximately 30-day intervals, beginning early July.

Manduca jasminearum (Guer.) (Fig. 6): two broods, peaking early June and mid August; similar brood times occur for *S. franckii*; previously reported by Beutenmuller (1895) as probably double-brooded near New York City.

Dolba hyloeus (Drury) (Fig. 7): six broods, first peaking in early April; peaks two through six occur at approximately 30-day intervals, beginning mid-May; occasional October specimens may indicate partial emergence of a seventh brood; previously reported by Rowley (1899) as probably double-brooded in Missouri.

Ceratomia amyntor (Geyer) (Fig. 8): five broods, first peaking in early April; peaks two through five occur at approximately 30-day intervals, beginning mid-May; previously reported by Hodges (1971) as having two broods in the south, by Covell (1984) as having two broods, and by Heitzman (1987) as having two broods in Missouri.

Ceratomia undulosa (Wlk.) (Figs. 9, 45, 46): six broods, first peaking in early April; peaks two through six occur at approximately 30-day intervals; initial brood emergence varying by two weeks from year to year; previously reported by Beutenmuller (1895) as double-brooded near New York City, and by Hodges (1971) and Covell (1984) as having two broods.

Ceratomia catalpae (Bdv.): five broods, first peaking in mid April; peaks two through five occur at approximately 35-day intervals, beginning late May; previously reported by Hodges (1971) and Covell (1984) as having two broods.

Ceratomia hageni Grt.: four or more broods; additional records are needed; previously reported by Hodges (1971) and Covell (1984) as having two broods, and by Heitzman (1987) as having three broods in Missouri.

Isoparce cupressi (Bdv.) (Figs. 10, 40–43): usually four broods, protracted initial brood usually peaking third week of March; peaks two through four occur at approximately 50-day intervals, beginning late May; initial emergence peak varying by three weeks from year to year; affecting emergence time of subsequent broods (and probably why in some years there are specimens representing five broods); previously reported by Covell (1984) as having two broods.

Paratrea plebeja (F.) (Fig. 11): six broods, first peaking early to mid April; peaks two through six occur at approximately 30-day intervals, beginning five weeks later; previously reported by Beutenmuller (1895) as double-brooded near New York City, by Hodges (1971) as having two broods in the south, and by Holland (1903), Rothschild & Jordan (1903), and Covell (1984) as having two broods.

Sphinx franckii Neum.: two broods, peaking approximately mid June and mid August; previously reported by Hodges (1971) and Covell (1984) as having one brood and a partial second.

Sphinx kalmiae J. E. Smith (Fig. 12): six broods, first peaking early to mid April; remaining peaks at approximately 30-day intervals; previously reported by Beutenmuller (1895) as double-brooded near New York City, and by Hodges (1971) as probably having two broods.

Lapara coniferarum (J. E. Smith) (Figs. 13, 47, 48): five broods, first peaking early to mid April (see Brou 1994); peaks two through five occur at approximately 30-day intervals, beginning mid-June; previously reported by Koebele (1881) as having at least two broods in the southern United States, and by Riotte (1972) as having two distinct flight periods in the south coastal states.

Lapara phaeobrachycerous Brou (Figs. 14, 37–39): five broods, first peaking about mid May (see Brou 1994); remaining peaks occur at approximately 30-day intervals.

Smerinthus jamaicensis (Drury) (Fig. 15): five or more broods, protracted initial brood peak approximately mid March; peaks two through four occur at approximately 45-day intervals, beginning early-June; November specimens may indicate a partial sixth brood; previously reported by Beutenmuller (1895) as being double-brooded near New York City, and by Heitzman (1987) as being multibrooded in Missouri.

Paonias excaecatus (J. E. Smith) (Fig. 16): four broods, first peaking late March; peaks two through four occur at approximately 45-day intervals, beginning early June; previously reported by Beutenmuller (1895) as double-brooded near New York City, by Rowley (1898)

as double-brooded in Missouri, by Hodges (1971) as having two broods in Florida, by Covell (1984) as having three broods, and by Heitzman (1987) as having several broods in Missouri.

Paonias myops (J. E. Smith) (Fig. 17): four broods, first peaking late March; peaks two through four occur at approximately 50-day intervals, beginning early June; previously reported by Beutenmuller (1895) as probably double-brooded near New York City, by Hodges (1971) as seemingly single-brooded, and by Heitzman (1987) as having multiple broods in Missouri.

Paonias astylus (Drury) (Fig. 18): four broods; limited data indicate it may have broods similar to other members of the genus; previously reported by Hodges (1971) as having two broods in Florida, and by Covell (1984) as having two broods.

Laothoe juglandis (J. E. Smith) (Fig. 19): four broods, peaking at approximately 45-day intervals, beginning late April; previously reported by Beutenmuller (1895) as double-brooded near New York City, by Hodges (1971) as having two broods in the south, by Covell (1984) as having three broods, and by Heitzman (1987) as having several broods in Missouri.

Pachysphinx modesta (Harr.): five broods, first peaking late March; peaks two through five occur at approximately 30-day intervals, beginning mid-May; previously reported by Beutenmuller (1895) as probably double-brooded near New York City, by Hodges (1971) as having two broods in Arkansas, Kansas, and perhaps Missouri, by Covell (1984) as having three broods, and by Heitzman (1987) as being multibrooded in Missouri.

Enyo lugubris (L.) (Figs. 20, 36): usually six broods, first peaking about mid July; peaks two through six occur at approximately 30-day intervals, beginning early September; broods five, six, and occasionally seven affected by cold weather during some years; previously reported by Holland (1903) as having two broods in Florida.

Hemaris thysbe (F.) (Fig. 21): six broods, first peaking end of March, and at approximately 30-day intervals; previously reported by Beutenmuller (1895) as double-brooded near New York City, by Rowley (1899) as double-brooded in Missouri, by Hodges (1971) as having two broods in the south, by Covell (1984) as having two broods, and by Heitzman (1987) as having three broods in Missouri.

Hemaris diffinis (Bdv.): four broods, first peaking mid April, and at approximately 50-day intervals; previously reported by Rowley (1899) as double-brooded in Missouri, by Hodges (1971) as double-brooded in the northern United States, and by Covell (1984) as having two broods.

Eumorpha pandorus (Hbn.) (Fig. 22): four broods, first peaking about mid May; peaks two through four occur at 30-day intervals, beginning early July; previously reported by Beutenmuller (1895) as double-brooded near New York City, and by Rowley (1899) as double brooded in Missouri.

Eumorpha intermedia (B. P. Clark) (Fig. 23): four broods, first peaking about mid May; peaks two through four occur at approximately 30-day intervals beginning late June.

Eumorpha fasciatus (Sulz.) (Fig. 24): six or more broods, first peaking in early May, and at approximately 30-day intervals; initial brood emergence varying by two weeks in any given year; November and December specimens may indicate partial emergence of seventh and eighth broods; previously reported by Hodges (1971) as having two broods in South Carolina, and Covell (1984) as having two broods.

Sphecodina abbottii (Swainson) (Figs. 25, 34): three or four broods, first peaking end of March, and at approximately 45-day intervals; initial brood emergence varying by more than two weeks in any given year; broods two and four occur at low numbers; previously reported by Heitzman (1987) as having two broods in Missouri.

Deidamia inscripta (Harr.) (Fig. 26): one brood, peaking at the end of March; previously reported by Beutenmuller (1895) as probably double-brooded near New York City, and by Hodges (1971) as having one brood.

Amphion floridensis B. P. Clark (Figs. 27, 49–51): six broods, first peaking end of March, and at approximately 25-day intervals; initial brood emergence varying by two weeks in any given year; previously reported by Hodges (1971) as multiple-brooded in the south, and by Covell (1984) as having two broods.

Darapsa versicolor (Cram.) (Fig. 28): five or more broods, peaking at approximately 30-day intervals; additional records are needed; previously reported by Beutenmuller (1895) as double-brooded near New York City, and by Forbes (1948) as having two broods.

Darapsa myron (Cram.) (Figs. 29, 33): five or more broods, first peaking early to mid April, and at approximately 30-day intervals; initial brood emergence varying by more than two weeks in any given year; September and October specimens may represent partial emergence of sixth and seventh broods; previously reported by Beutenmuller (1895) as double-brooded near New York City, by Hodges (1971) as double-brooded in New York and South Carolina, and by Covell (1984) as having two broods.

Darapsa pholus (Cram.) (Figs. 30, 35): seven broods, first peaking end of March, and at approximately 30-day intervals; initial brood emergence varying by two weeks in any given year; second, fourth, and seventh broods usually at low numbers; November specimens may represent partial emergence of an eighth brood; previously reported by Beutenmuller (1895) as double-brooded near New York City, by Rowley (1898) as having two broods in Missouri, and by Lutz (1948), Hodges (1971), and Covell (1984) as having two broods.

Xylophones tersa (L.) (Fig. 31): six or more broods, first peak variable, usually at the start of May; peaks two through six occur at approximately 30-day intervals, beginning mid-June; occasional late year specimens appear, probably representing partially emergent subsequent brood(s).

Hyles lineata (F.) (Figs. 32, 52): eight or nine broods, variable first peak late February to early March, and at approximately 30-day intervals; previously reported by Beutenmuller (1895) as double-brooded near New York City.

ACKNOWLEDGMENTS

We thank the following individuals who supplied specimens or records, or aided in the successful completion of this project: Gary Adams, Linda and Phil Auld, Howard D. Baggett, April R. Brou, Joan B. Chapin, Kevin J. Cunningham, Douglas C. Ferguson, H. Avery Freeman, Lawrence F. Gall, Michael L. Israel, Rodney Jung, Jonathan Kemp, Rick Kergosien, Michael T. Lefort, Zack Lemann, Michael Lockwood, Bryant Mather, Eric H. Metzler, Eric L. Quinter, Gayle Strickland, Howard V. Weems Jr., and Frances C. Welden.

LITERATURE CITED

BEUTENMULLER, W. 1895. Descriptive catalogue of the Sphingidae found within fifty miles of New York City. Bull. Am. Mus. Nat. Hist. 7:275–320.

BROU, V. A. 1980. New status for *Eumorpha intermedia* (Sphingidae). J. Lepid. Soc. 34:302–306.

———. 1992a. Extended duty bait trap designed for continual year-round use. Southern Lepid. News 14:4–6.

———. 1992b. Plain talk for entomologists about ultraviolet light. Southern Lepid. News 14:20–23.

———. 1994. New species of *Lapara* (Sphingidae) from southeastern United States. J. Lepid. Soc. 48:51–57.

CLARK, B. P. 1917. New Sphingidae. Proc. New England Zool. Cl. 6:57–72 .

COVELL, C. V., JR. 1984. A field guide to moths of eastern North America. Houghton Mifflin Co., Boston. 469 pp.

DRAUDT, M. 1931. Family Sphingidae. *In* A. Seitz (Ed.), The macrolepidoptera of the world, Vol. 6. Alfred Kernan, Stuttgart.

FORBES, W. T. M. 1948. Lepidoptera of New York and neighboring states, Part II. Cornell Univ. Agric. Exp. Sta. Mem. 274:1–263.

FREEMAN, A. 1938. Notes on the Sphingidae (Lepidoptera) of Arkansas. Field and Laboratory 6:33–43.

HEITZMAN, J. R. & J. E. HEITZMAN. 1987. Butterflies and moths of Missouri. Missouri Dept. Conservation. 385 pp.

HINE, J. S. 1906. A second contribution on the entomology of the region of the Gulf Biologic Station. Gulf Biol. Sta. 6:65–83.

HODGES, R. W. 1971. The moths of America north of Mexico, Fasc. 21, Sphingoidea. E. W. Classey Ltd. & R. B. D. Publications. 158 pp.

——— (Ed). 1983. Check list of the Lepidoptera of America north of Mexico. E. W. Classey Ltd. & The Wedge Entomol. Res. Foundation, Cambridge Univ. Press. 284 pp.
HOLLAND, W. J. 1903. The moth book. Doubleday, Page & Co., New York. 479 pp.
JUNG, R. C. 1950. An annotated list of the Lepidoptera of the New Orleans area. Proc. Louisiana Acad. Sci. 8:42–48.
KOEBELE, A. 1881. Descriptions of and notes upon various larvae. Bull. Brooklyn Entomol. Soc. 4:20–22.
LUTZ, F. E. 1948. Field book of insects. G. P. Putnam & Sons, New York. 510 pp.
MERKL, M. E. & T. R. PFRIMMER. 1955. Light trap investigations at Stoneville, Miss., and Tallulah, La., during 1954. J. Econ. Entomol. 48:740–741.
NECK, R. W. 1991. Hawkmoths (Sphingidae) in the Whitley collection from Walker County Texas. J. Lepid. Soc. 45:231–233.
OTTOLENGUI, R. 1894. Entomol. News 5:314.
PFRIMMER, T. R. 1957. Response of insects to different sources of blacklight. J. Econ. Entomol. 50:801–803.
PLATT, A. P. 1969. A lightweight collapsible bait trap for Lepidoptera. J. Lepid. Soc. 23:97–101.
RIOTTE, J. C. E. 1972. A review of the North American hawk moth genus *Lapara* (Lepidoptera: Sphingidae). Life Sci. Contr., Royal Ontario Mus. No. 79:1–40.
———. 1980. *Sphinx poecila*, a valid North American hawkmoth species (Lepidoptera: Sphingidae). Great Lakes Entomol. 13:115–130.
ROTHSCHILD, W. & K. JORDAN. 1903. A revision of the lepidopterous family Sphingidae. Novit. Zool., ix suppl. cxxxv + 972 pp.
ROWLEY, R. R. 1898. Notes on Missouri sphinges. Entomol. News 9:189–191.
———. 1899. Notes on Missouri Sphingidae. Entomol. News 10:10–12.
SELMAN, C. L. & H. E. BARTON. 1971. The relative abundance, seasonal distribution and taxonomy of the Sphingidae of northeast Arkansas. Ark. Acad. Sci. Proc. 25:56–68.
TAYLOR, R. & B. TAYLOR. 1965. Collecting sphingids and other moths on the Mississippi Gulf Coast. J. Lepid. Soc. 19:189–190.
VON REIZENSTEIN, L. 1863. Catalogue of the Lepidoptera of New Orleans and its vicinity. Isacc T. Hinton, New Orleans. 8 pp.
———. 1881. Scribner's Monthly 22:864.

Received for publication 10 March 1993; revised and accepted 24 March 1996.